SOME SCIENTIFIC CENTRES.

VI.—THE PHYSICAL LABORATORY AT THE MUSEUM D'HISTOIRE NATURELLE.

THE Museums d'Histoire naturelle, in the beautiful surroundings of the Jardin des Plantes in Paris, founded in 1793, form an institution of acknowledged eminence; whilst the lectures delivered there are by the most renowned professors, and on most, if not all, branches of the natural sciences. It was Cardinal Richelieu, as we know, who founded the Jardin des Plantes somewhere about 1626, not long before the establishment of the French Academy by the same great Minister of State.

The physical laboratory in particular of these museums has been the seat of many discoveries and the centre from which has radiated some of the best thought, as well as some of the best work, that has animated the academy and through it the scientific world for three-quarters of a century. It is not often the case with science, nor, indeed, with other branches of learning, that in a single family there should be found for three generations a series of distinguished men of the highest order of intellect who have devoted their lives and best energies to its pursuit and attained to universal fame. More seldom is it, then, that when the lineage is thus preserved unbroken, the members thereof should all be devoted to the one and to the self-same calling. For three generations the Becquerels have occupied in succession the same chair at the same institution, namely, the Museum d'Histoire naturelle in Paris. The number of papers which have been read before the Academie des Sciences by the Becquerels extends to seven or eight hundred.

Henri Becquerel, whose portrait in his laboratory at the Museum d'Histoire naturelle is here reproduced, is, we venture to think, perhaps the most distinguished of his race. His father, Alexander Edmond, is known as the inventor of the phosphoroscope and the author of "La Lumière," a work of great value in its day, whilst his grandfather, Antoine César, was likewise famous for a long series of researches, chiefly on chemical dynamics and electrocapillary phenomena. His electromagnetic balance is of historic interest in the development of the galvanometer, although long since abandoned for practical purposes.

Thus the history of the physical laboratory at the Museum d'Histoire naturelle may be said to run parallel with the history of the Becquerels, and the two to be so closely interwoven that to describe the part played by one and the influence exerted by it in the development and advancement of knowledge is perhaps equivalent to writing that of the other in detail. It was not so with other scientific centres of this series; there there were many discontinuities, here the continuity is one.

The technical process of gilding due to de la Rive was based upon Becquerel's observation in 1834 of the deposition of metals on the negative electrode when the poles of a pile are immersed in solutions of various metallic salts; that the two solutions needed could be kept apart by the use of animal membranes without preventing the passage of the current, and that with very feeble currents the deposition of metal is even and uniform on the surface of the electrode. Although rivalled by many others in the application of these principles, many were the facts and many the methods which he announced with rapid succession in laying the foundations of the art of electro-plating.

It was to the study of electrocapillary phenomena, which he was the first to observe in 1867, that his later years were devoted. The discovery was a curious one, the result, if we mistake not, of the deposition of

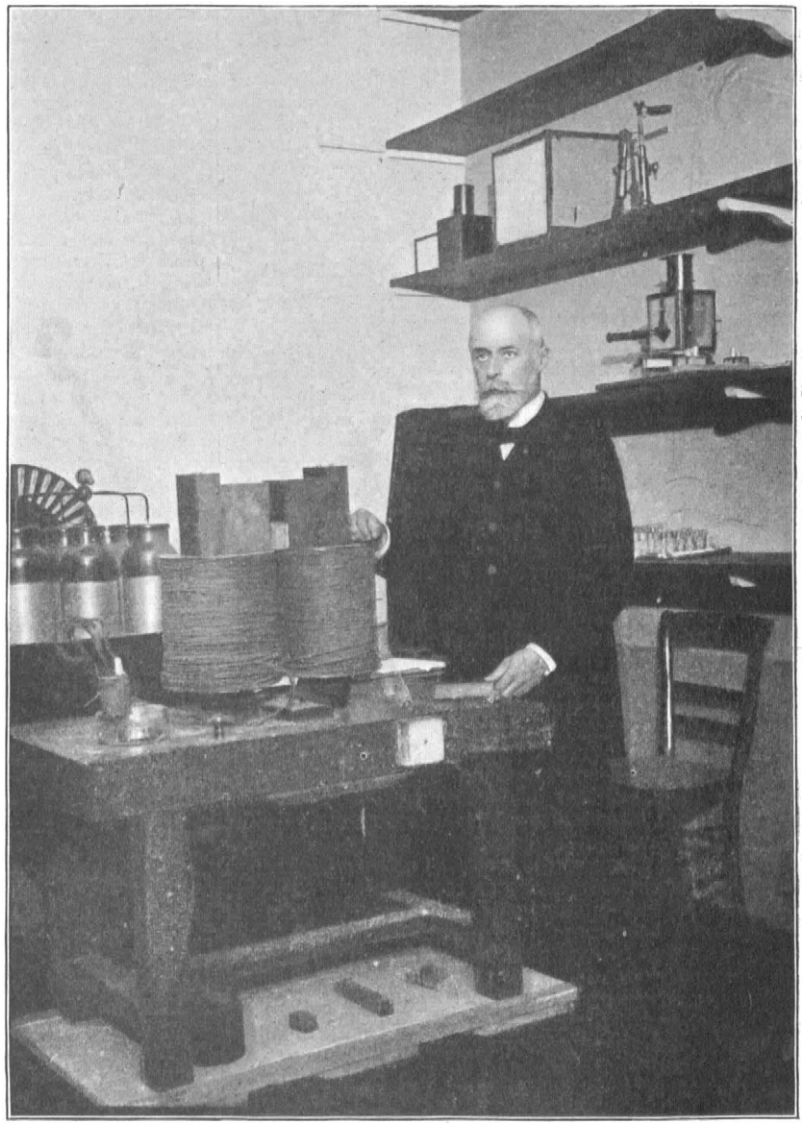

FIG. 1.—Prof. Henri Becquerel in his Laboratory at the Paris Museum d'Histoire naturelle.

metallic copper on a crack in a test-tube containing a solution of cupric sulphate, and immersed in another solution of sodic sulphide. The investigation of this phenomenon was full of interest, and not the least was the suggestion that the deposition of metals in veins in rocks is due to the same cause as that which he observed in the broken test-tube.

A member of the French Academy from 1829, eight years before being called to the chair which he filled to the end of his life, he was also a corresponding member of the Royal Society, and received from it its greatest honour, the Copley medal, and from the Emperor Napoleon III. the Cross of Commander of the Legion of Honour. Thus with him there closed a chapter, a long, an interesting, and an eventful chapter, in the history of the Museums d'Histoire naturelle.

Edmond Becquerel, although a pupil of his father and for a considerable time his assistant at the museums, did not teach there, and, indeed, as Sir William Crookes has said in his obituary notice of him in the *Proceedings* of the Royal Society, of which he was a foreign member, it may "be remarked that though he had early distinguished himself by scientific works of high value, and as the son of an eminent and much respected Academician he was not without influence, yet none of the great scientific establishments of his country offered him an appointment." He finally, however, secured a permanent position at the Conservatoire des Arts et Métiers, and there the abilities so long latent had full play, and manifested themselves by the success of his subsequent career.

At the death of his father, in 1878, he succeeded to the chair of physics at the museum, and this important position he continued to hold until his death in 1892. Brought up as he was in a scientific atmosphere, he evidently inherited from his father his "acute power of observation," and that "infinite capacity of taking pains which seems to be the essential characteristic of the Newtons, the Faradays, and the Darwins, and, in short, of all the great leaders of science."

Since 1892 Henri Becquerel has been professor at the Museum d'Histoire naturelle, and has continued those studies which his ancestors in days gone by pursued with ardour and with success, not the less marked, although perhaps, on the whole, notwithstanding their brilliant achievements, less fruitful in revealing that knowledge which was to come; for by his memoirs on the radio-activity of matter Henri Becquerel has given to the world of science the results of a very remarkable series of researches.

There are four methods of studying the infra-red parts of the spectrum: the thermopile, as employed by Tyndall and others, the radiomicrometer of Boys, the bolometer as used by Langley, and the phosphorescent screen of Becquerel. After exposure to the violet rays, and if the screen is subjected to the action of the infra-red, the phosphorescence becomes so intense that the energy accumulated is radiated so rapidly that the parts thus acted upon become quite dark relatively to the other parts of the screen. Thus a map of the infra-red can be produced and studied at leisure so long as the phosphorescence of the screen lasts, or, indeed, photographs of the screen thus affected may be taken. The effect is due most probably to heat, and is therefore a case of thermoluminescence. Under the influence of heat the collisions between molecules become more frequent and more violent, and the energy absorbed from the more refrangible rays, and stored up in the substance, by some means at present not very clearly understood, is once more yielded up to the æther and radiated away. The energy is stored up in unstable molecular aggregates which gradually disintegrate, as radio-active molecules have been found to do,[1] the change of absorption which accompanies fluorescence being due to the formation of these molecular groups.

The absorption spectrum of crystals exhibits many anomalies, from which Becquerel has extracted a most important principle. If a crystal is composed of two isomorphous substances the molecular elasticity of which varies in different directions, so that the absorption varies too, the absorption spectrum will likewise vary in different directions, so that it is thus possible to detect the presence of different substances, since in two isomorphous substances the directions of molecular elasticity do not correspond, and therefore the directions of absorption would likewise differ. Each chemical substance, therefore, affects the direction of propagation and of absorption.

If the directions of absorption do not coincide with the optic axes, it is due to the presence of different isomorphous substances in the crystal. The absorption spectrum of each substance remains different and in its own particular direction, whilst that of refraction is the resultant effect. By this contrivance the composition of crystals has been examined and afterwards confirmed by chemical means, whilst in many instances the presence of substances in quantities too minute for the chemist to notice has been detected by this elegant method of analysis.

But the most striking work that has issued from Becquerel's laboratory relates to the radio-activity of matter. Of this great discovery, separating as it does the ideas of this century from those of the last, so much has been written, upon their far-reaching importance, so many ideas have been discussed in these columns, that to discourse upon them here would be but vain repetition of all that has been said before; yet, paradoxical though it may seem, it is unquestionably the work of all works that most definitely separates, and at the same time most closely unites, the two sciences of physics and chemistry, whilst it brings into prominence what may appropriately be called a new science—that of radio-activity—a science which neither physics nor chemistry can claim within its old province, and yet neither can disclaim, nor would it very readily do so if it could.

What is the influence which these laboratories have exerted and exert? We may ask, what is the influence of the Royal Institution? Is it not to be measured by the work which has been done there and by the ideas which have been scattered from those great fountains of thought—if they can be measured? How many youthful imaginations, how many enthusiastic aspirations have been aroused within those venerable halls, of the Becquerels as of the Davys, the Faradays, and the Tyndalls? Parisian lecturers are *savants*, philosophers, and orators. For although the Teuton regards the gift of eloquence (we hope it is his own) as the gift to be designated as "gab," the southerner or the Celt thinks it indispensable in the expression of a clear mind and of a great soul, at once saturated with thoughts and the grandeur of its subject; and in France this counts for more than it usually does among us.

These lectures are a source of inspiration to the multitude as well as to the grave, and their importance cannot be overrated.

Having said thus much of the laboratories of the Museum d'Histoire naturelle, we may perhaps be permitted to add a word as to the central figure in this centre of scientific thought, of M. Henri Becquerel; from none need we expect greater freedom, greater ease, or kindlier consideration. The brief summary

[1] British Association and *Electrician*, 1900–02; and *Phil. Mag.*, 1901 *Phil. Trans.*, 1897[5]

of his researches and of that of his predecessors is the record of this branch of the museums, and also of the debt which knowledge owes, and must ever owe, to the influence of one of he most remarkable of the pioneer laboratories and great European centres of scientific work.

JOHN BUTLER BURKE.

THE "NATURE-STUDY" OF BIRDS.[1]

THIS book fulfils the chief conditions we have previously insisted upon as being essential in all new works relating to the birds of the British Isles, in that it is original, interesting, exquisitely illustrated from living subjects, and not burdened with technical names. Indeed, the latter are conspicuous by their complete absence, thereby, no doubt, rendering the volume much more acceptable to readers of all classes than it would have been had it included the usual superfluous intercalations in bracketed italics. Mr. Boraston, it appears, took to the "nature-study" of birds comparatively late in life, and in his case it may be truly said "better late than never," for had he never done so lovers of nature in general, and of birds in particular, would have been deprived of a very charming volume containing a number of fresh ideas and suggestive observations. Having once decided to take up the outdoor study of bird-life, the author entered on his task with characteristic energy, and at once saw how essential it was for him to follow in the steps of the Messrs. Kearton and to employ the camera to perpetuate the scenes that he so much enjoyed if his work was to be one that would appeal successfully to the public.

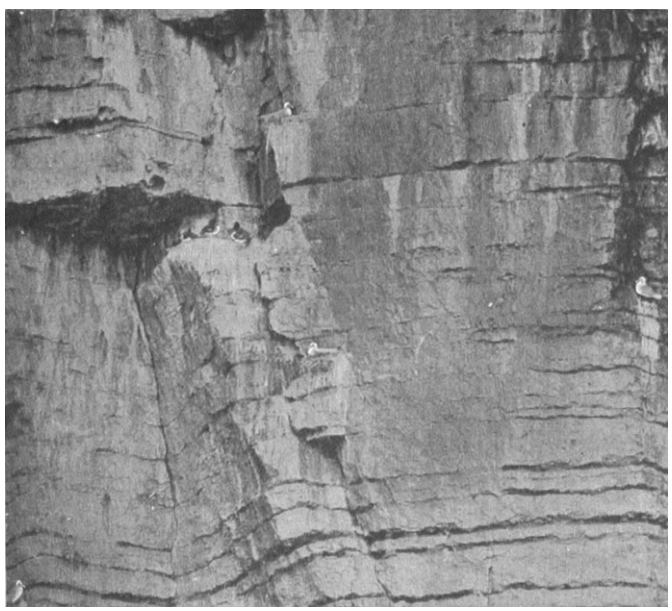

FIG. 1.—Kittiwakes on an Anglesea Cliff. From "Birds by Land and Sea."

How successful have been the results, both from the literary and the artistic point of view, readers of his book will not, we venture to think, be long in deciding. To whet their appetites, we herewith reproduce

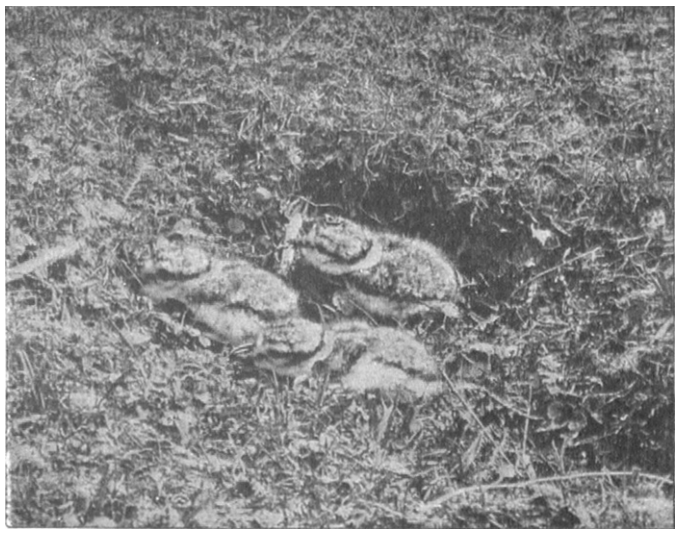

FIG. 2.—Young Ringed Plovers crouching. From "Birds by Land and Sea.'

a couple of the illustrations, all of which, by the way, are taken from the author's own photographs.

The volume opens with the latter of what the author terms the two critical periods of bird-life, namely, March and September, when the migratory species are in the thick of their departure from or arrival at the British Islands. From September until May the seasonal observations of the year forming the subject of the volume relate to the bird-life of the neighbourhood of the author's home at Stretford, near Manchester, but during June the scene is transferred to the wild coast of Anglesea and Puffin Island, while in July and August we once more return to the home district. Perhaps the Anglesea interlude forms the most interesting part of the volume; but whether on a holiday or whether at home, the author seems to be endowed with a marvellous capacity for work, both in the matter of making and recording observations and in taking photographs.

On the wild cliffs of Anglesea, as we are told on p. 210, "stalking" birds for the purpose of taking their portraits by a well planned snap-shot demands a considerable amount of coolness and steadiness on the part of the observer, as if he becomes too much absorbed in the object of his pursuit awkward accidents are likely to occur; and even if such undesirable contingencies are successfully avoided, disappointments from unsuspected or unavoidable causes are only too likely in many instances to annul the results of all the toil and trouble. Who, for instance, will fail to commiserate the author on having lost the chance of "snapping" a sitting nightjar (p. 202), from the fact that he actually did not see the bird for some seconds, and then, when "his eyes were opened," the camera slipped?

[1] "Birds by Land and Sea: the Record of a Year's Work with Field glass and Camera." By J. M. Boraston. Pp. xiv+282; illustrated. (London: John Lane, 1905.) Price 10s. 6d. net.